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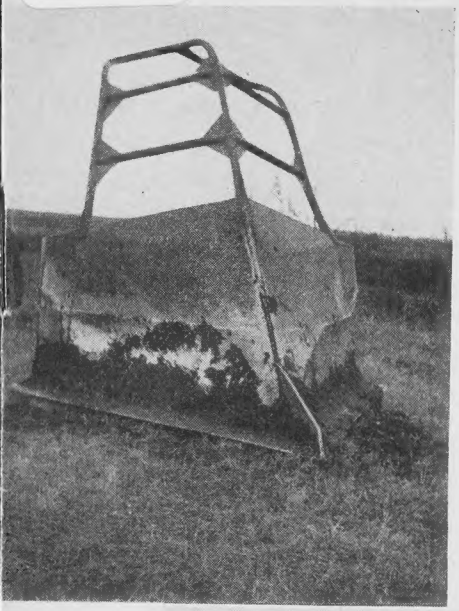

A modern cutter.

Use of POWER MACHINERY in Bush Land Improvement in Northeastern Saskatchewan

M. E. ANDAL

A root picker hydraulically mounted on Ford tractor, which rakes the roots into windrows from which the roots are burned or carried away. A step towards mechanization of root picking.

A modern piler. The spaced projecting prongs allow dirt to fall through.

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Use of Power Machinery in Bush Land Improvement in Northeastern Saskatchewan

M. E. Andal[1]

INTRODUCTION

The grey wooded and degraded black virgin soil of northeastern Saskatchewan is characterized by a growth of tree cover. The cover ranges from light to heavy and is a barrier to the agricultural development of the land. Like many other enterprises, land improvement methods are going through a revolutionary period, in which slow, laborious, hand methods are yielding to fast and powerful land clearing machinery. This almost complete changeover has several implications, the results of which cannot be determined without considerable study.

In this changeover from hand to power clearing, it is necessary to weigh the advantages of the immediate availability of crop land and with it income potentiality against the large initial outlay of capital represented by the high cost of power clearing. This modernization of land clearing points to a change in farm organization and farm finance. While indicating a change in organization and finance, it also points to new difficulties where farmers are confronted with inadequate credit facilities.

Provision is made by the Provincial Department of Municipal Affairs for limited grants to needy settlers for the development of their farms. These are designed only to assist settlers in financing a clearing project and are not meant to be adequate in themselves for a full improvement program. An extension of these grants or loans would give power clearing a further impetus and might alleviate some of the hardships and insecurities of slower land improvement methods.

In the pioneer areas study of 1941-42[2], it was shown that the rate of clearing and breaking averaged from 4·5 to 9 acres annually, and until a farmer had approximately 60 acres of crop land a negative net income was indicated. Thus during the earlier stages of development the farm was not on a paying basis. This suggests the desirability of rapid power clearing methods in speeding up land improvement, with a possible bearing on land settlement policies.

With this in mind, a study was made to obtain from operators such information as farmers' costs for clearing and piling by power machinery; actual operation costs, together with general information on clearing practices.

AREA

The 1946 survey included areas in the vicinity of Melfort, Tisdale, Nipawin, Carrot River, Quill Lake and Invermay. Generally, the more northerly part of the area is characterized by a heavier bush cover than the southern areas.

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1. Assistant Economist, Economics Division, Marketing Service, Dominion Department of Agriculture, located at the University of Saskatchewan, Saskatoon.
2. Stutt, R. A. and Van Vleit, H., *An Economic Study of Land Settlement in Representative Pioneer Areas of Northern Saskatchewan.* Economics Division, Dominion Department of Agriculture, in co-operation with the Department of Farm Management, University of Saskatchewan, Saskatoon.

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In all, twenty-five records were obtained. Because the development of this type of enterprise on a general scale is very recent, nearly all of the information applies to 1946 operations.

EQUIPMENT

Tractors.—Large, diesel, crawler-type tractors provide the power for the clearing and piling operations. While the range in size varies from 30 to 132 horse power, most units are over 60 horse power. These make more satisfactory power units, being better adapted to the heavy work for which they are used.

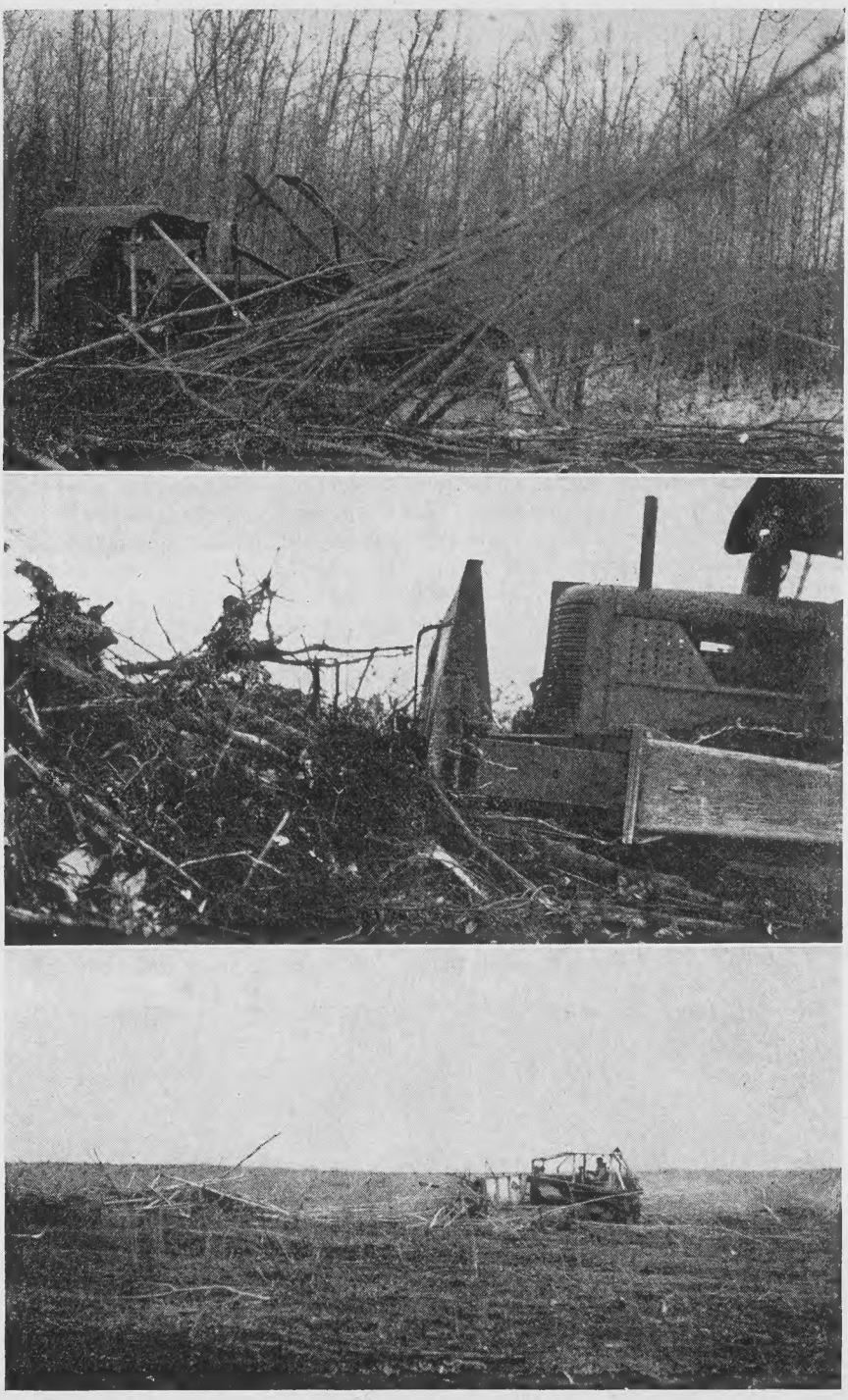
Cutters.—The cutter consists of a V-shaped shearing blade mounted on a heavy steel frame. Blades are detachable and can be replaced when worn out or damaged. A network of steel over the tractor protects the tractor and operator from falling trees. The width of cutters varies from 8 to 15 feet, depending on the size of tractor. The cutter is pushed forward by the tractor and shears off trees at about the ground level. The cutter weighs from 1 to 2 tons.

Pilers.—The piler consists of a solid steel breastwork with teeth or prongs that protrude about 10 to 12 inches below the solid plate. The teeth project forward from 3 to 16 inches and assist in carrying the brush into the pile. The teeth are from 1 to 2½ feet apart and allow dirt to pass through. Thus the dirt is not carried into the pile. With the piler, slash is pushed into windrows for burning. Occasionally, the slash is burned without first being piled. Sometimes, too, piles are made into long, straight windrows which allow breaking between them. This allows immediate breaking without waiting the customary year for the piles of bush to dry before most of the land can be broken. The piler weighs about one ton and is very heavily constructed. It is capable of tearing out small roots and splitting the larger ones, which facilitates breaking.

Bulldozers.—The bulldozer is simply a heavy steel breastwork which is used for pushing and not for cutting. It is sometimes used for general clearing, but is not as satisfactory as the V-shaped cutter for this purpose. The place of the bulldozer for general clearing may be justified when very heavy stands of timber exist or where logs have been removed leaving large stumps. The bulldozer is the only machine that will remove these, but the cost has run as high as $25 per acre. The bulldozer is sometimes used to supplement the work of the cutter. The cutter shears off trees leaving the roots in the ground. The bulldozer uproots trees and takes part of the root system with it, thus facilitating the breaking process. Large trees are sometimes left by the cutter to be bulldozed out. Breaking is then easier to do and can be done with ordinary farm tractors. Under certain conditions, the bulldozer removes large quantities of dirt with the root system and leaves a large pit with exposed subsoil.

Each of these attachments requires a certain degree of flexibility in its attachment to the tractor, which permits them to follow the contour of the ground. Various types permit such flexibility with varying degrees of efficiency and adequacy. One type of attachment is simply a hinge whereby the cutter slides along the ground on shoes and is kept down by gravity. While this simple attachment is fairly satisfactory under certain conditions, such as reasonably level land, firm soil and freedom from stones, it is unsatisfactory under other conditions.

The cable lift on the cutter is popular with many operators. It allows the cutter to be lifted in soft ground, lifted over stones, etc. Again, gravity is used to lower the cutter. The cable lift is less suited for piling since there is often a tendency for the piler to lift over the trash when the weight of the piler is not enough to keep it down.



UPPER—This cutter clears 2 to 3 acres of light bush per hour.
MIDDLE—Piler with 132 horse power tractor tears out or splits solid roots.
LOWER—The piler carries slash into windrows.

The hydraulic lift on the cutter is preferred by some since the cutter can be shifted up or down very easily. The cable lift is given preference by some operators due to the danger of the hydraulic tubes being punctured by branches and dry sticks of wood. The hydraulic lift has proved more satisfactory on pilers since the piler can be held down to do a clean and efficient job of piling. The hydraulic lift is used exclusively on bulldozers.

Other Equipment.—A considerable number of accessories are required for a complete outfit. Some means is required to blow dirt, leaves and flowers out of the tractor radiator. This is done with compressed air or water pressure. Blades require sharpening at least once a day. The frequency of sharpening depends on the size and kinds of bush and the number of stones. Grinders are generally mounted on flexible shafts for the purpose of sharpening blades. Compressors and grinders are powered by small stationary engines or by electricity generated by accompanying mobile electric light plants. These plants, when used, also supply light for the bunk house and around the machines for general repair work. Frame breakages are common on the outfits in heavy work. Some operators, rather than rely on the facilities of local garages, carry their own arc welding outfit with them. Sleeping quarters for the crew are usually provided by the operator. This consists of a bunk house which has accommodation for from 4 to 6 people. Most outfits carry a 500 gallon fuel tank with them. A large tank allows the settling of the diesel fuel oil and lessens the danger of sludge being mixed with the fuel as it goes into the tractor. Rubber-mounted trailers are often used for moving the piler and the cutter. A trailer is used to carry tools, fuel, grease, etc. A car or truck is considered to be a necessity with each outfit. A fairly wide range of tools is also required to meet the varying needs. While all outfits do not have all of these accessories, the necessary extra equipment represents a considerable investment.

OPERATIONAL METHODS AND COSTS

Bush Clearing

Bush cutters are able to operate for a relatively long season. Operations are generally halted during the coldest winter months of December, January, February and March, although cutters can and sometimes do work during the entire winter season. The break-up period during the spring halts all operations

Root picking generally remains to be a laborious manual operation.

UPPER—Large trees are pushed over with the bulldozer.
MIDDLE—Roots are torn out of the ground when bulldozed out, thus facilitating the breaking and root picking operations.
LOWER—Beaver dams are easily levelled with the bulldozer.

since the ground is so soft that the heavy outfits cannot work. The average length of season for scrub cutting is 6·7 months. In small local areas farmers will not have their scrub cut except when the leaves are on the trees. Their argument for such a policy is that the sap is distributed through the trunk, branches and leaves of the tree at that period of the year and the roots will decompose much quicker. The validity of such a reason is questionable.

After the scrub is piled there is still burning, breaking, root picking and the working down of the land before it is ready for seeding. Root picking remains as the only major manual operation of the process of land clearing. During the course of the survey, one farmer was interviewed who had devised a mechanical root picker or rake. The picker consists of heavy teeth in a frame which juts downward into the soil. The frame is mounted on a tractor and the picker is hydraulically controlled. Roots are then raked into windrows where they can be burned or carried away.

Rates of Clearing and Piling

Some difficulty was experienced in arriving at comparative rates of doing work because of the variability in types of cover and the difficulty of arriving at definite standards of the types and densities of cover. Tree cover was described as light, medium and heavy.

Table 1 shows the average rates of clearing and piling.

TABLE 1.—AVERAGE RATES OF CLEARING AND PILING IN ACRES PER HOUR BUSH LAND IMPROVEMENT SURVEY, 1946

Density of Cover	Clearing				Piling			
	Horse Power Rating							
	60 and Over		Under 60		60 and Over		Under 60	
	Acres Acres per hour	No. No. of estimates	Acres Acres per hour	No. No. of estimates	Acres Acres per hour	No. No. of estimates	Acres Acres per hour	No. No. of estimates
Light	3·1	11	2·3	3	2·2	6	2·5	5
Medium	2·2	14	1·2	10	1·5	7	1·2	5
Heavy	1·2	12	1·5	3	1·0	6	1·4	2

This table indicates that the piling operation is somewhat slower than clearing. Clearing is simply a forward movement with the cutter. Piling, however, involves backing up as much as half of the time with a resultant slower rate of doing work.

Custom Charges and Costs per Acre to the Settler

The custom charges were almost exclusively on an hourly basis. Custom charges were usually the same irrespective of whether for clearing or piling. In two cases operators gave the option of an hourly charge or a contract price per acre. The hourly charge ranged from $8 to $16 per hour with many of the rates ranging from $12 to $15 per hour. The average hourly charge was $11.75 per hour. On this basis the average cost per acre to the settler can be determined. These have been divided into two groups. Tractors with a horsepower rating of 60 and over are in one group and tractors with a horsepower rating of less than 60 in the other.

TABLE 2.—AVERAGE COST PER ACRE OF CLEARING AND PILING ACCORDING TO SIZE OF TRACTOR BUSH LAND IMPROVEMENT SURVEY, 1946

Size of Tractor	No. of Machines	Light Cover			Medium Cover			Heavy Cover		
		Clearing	Piling	Total	Clearing	Piling	Total	Clearing	Piling	Total
		Dollars per acre								
60 h.p. and over.....	15	4·26	5·94	10·20	5·72	8·00	13·72	11·02	13·50	24·52
Under 60 h.p...	13	4·37	5·84	10·21	6·41	8·94	15·35	11·33	12·50	23·83
All sizes.....	28	4·31	5·92	10·23	6·05	8·51	14·56	11·16	13·00	24·16

As was suggested in the table of rates for clearing and piling, the piling operations are more costly than clearing. This is shown in table 2. The piling costs are from about $1.60 to $2.50 per acre more than clearing costs. There was not a great deal of difference in costs for outfits of different size, although table 2 suggests that the larger outfits might be a little cheaper. This is subject to the reliability and comparability of the different rates of clearing given by the different operators.

In addition to these direct cash costs, the farmer must also, in nearly all cases, provide board to the crew. It is evident therefore that clearing and piling operations involve a large expense, often of such proportions that it cannot be financed by the farmer.

Operating Costs

Information was also obtained on the operating costs to the owner of the machines. These included expenditures for fuel, oil, labour and repairs. Fuel, oil and labour expenses were easily calculated on the per-hour basis. Repairs, however, were given as a lump sum for the year. Repairs were calculated on a per-hour basis by first determining the number of hours from total acres cleared and piled during the season and average rates of operation.

Interest charges may be calculated on two bases, each of which may be justified under certain conditions. The first represents what might be an alternative investment. That is, the return which could be expected from sound investments. A rate of 3 per cent would be an adequate figure on this basis. The second is the rate which would have to be paid on borrowed capital. A rate of 6 per cent would be justified under these conditions. Both these interest charges are shown for investment charges. These are charged on half of the original investment, based on the assumption that equipment was at half-way lifetime use.

The calculation of an adequate depreciation charge presents some difficulties. Most of the tractors are used during the winter months on some other type of work such as logging. Depreciation charges must be allotted on the basis of proportional use in the scrub-cutting enterprise. Professor E. A. Hardy, head of the Agricultural Engineering Department, University of Saskatchewan, estimates that the lifetime of tractors in this type of work would be 10,000 hours. The yearly depreciation charge was then determined on the basis of the number of hours of use in scrub-cutting. The hourly depreciation was calculated by dividing the new value by the lifetime of the tractor in hours. A straight 10 per cent was taken as the depreciation charge on equipment other than the tractor.

A certain charge must be allowed for starting gas and grease. While information in this regard was limited, the charges shown for this item were believed to be fairly adequate.

The various items of expense are shown in table 3.

TABLE 3.—AVERAGE OPERATING COST PER HOUR FOR CLEARING AND PILING OUTFITS ACCORDING TO HORSE POWER RATING OF TRACTOR, BUSH LAND IMPROVEMENT SURVEY, 1946

Item	Horse Power Rating of Tractor			
	60 and Over		Under 60	
	Dollars per hour	No. of estimates	Dollars per hour	No. of estimates
Fuel	0·71	15	0·39	15
Oil	0·07	15	0·08	15
Labour	2·03	15	1·77	15
Repairs	0·99	13	0·77	11
Misc.: Starting Gas, Grease, etc.	0·30		0·25	
Total Operating Cost	4·10		3·26	

In addition to these operating costs, interest and depreciation charges form part of the total cost. These are shown in table 4.

TABLE 4.—AVERAGE INVESTMENT, INTEREST AND DEPRECIATION CHARGES FOR CLEARING AND PILING OUTFITS ACCORDING TO HORSE POWER RATING OF TRACTOR, BUSH LAND IMPROVEMENT SURVEY, 1946

——	No. of Estimates	Investment	Depreciation Charges per Hour	Interest Charges per Hour at		Interest and Depreciation per Hour	
				3%	6%	3%	6%
		Dollars					
Tractor, 60 h.p. and over	15	7,506	0·75	0·12	0·24	0·87	0·99
Other equipment	15	3,556	0·36	0·06	0·12	0·42	0·48
Total		11,062	1·11	0·18	0·36	1·29	1·47
Tractor, under 60 h.p.	15	4,908	0·49	0·13	0·26	0·62	0·75
Other equipment	15	2,941	0·29	0·08	0·16	0·37	0·45
Total		7,859	0·78	0·21	0·42	0·99	1·20

The total cost per hour for outfits with tractors of 60 horsepower and over in size averaged $5.39 allowing a 3 per cent investment charge, and $5.57 with an allowance of 6 per cent as an investment charge. Average costs per hour for outfits with a tractor less than 60 horsepower rating were $4.25 allowing a 3 per cent investment charge and $4.46 with a 6 per cent investment charge. Thus there is an average differential of about $1.00 per hour in the cost of operating the two size ranges of outfits.

The cost analysis above must be qualified by certain limitations. All of the costs are calculated on a per-hour basis. The number of hours used for the calculations was only the number of hours paid for by the farmer. This total would not include moves and short stops when a certain amount of expense was incurred. This would have the effect of showing fuel, oil and tractor

depreciation expenses too low. The deviation would not be very great, however, unless a large proportion of the time was spent in moving. The exclusion of moving time would make no difference on the validity of the labour costs, since in most cases labour was paid only for the time that the farmer was charged.

The repair item includes repairs for the full calendar year. These are charged solely to the scrub-cutting enterprise. Many of the tractors are used for logging during part of the winter season, and part of the tractor repairs should be charged to that enterprise. Lack of complete information on the relative time spent in each enterprise imposed difficulties in allocating the proportional repair expenses to each enterprise.

Similarly, tools and some equipment, such as lighting plant, air compressor, etc., may be used in some of the other enterprises. Part of their unkeep costs should correctly be charged to those enterprises. Again incomplete data made the proportional allocation of these charges difficult and they were charged completely to the land improvement enterprise.

INCOME OF CUSTOM OUTFIT OPERATORS

The average hourly charge for cutting and piling was $13.00 for outfits with tractors with 60 horsepower and over, and $9.00 for outfits with tractors less than 60 horsepower in size. For the larger tractors, the net profit, after allowing a 3 per cent investment charge, was about $7.50 per hour, and with a 6 per cent investment rate the net profit would have been 18 cents less. For the outfits with smaller tractors, under 60 horsepower, the net profit after allowing for a 3 and 6 per cent investment charge was $4.75 and $4.54 per hour, respectively. The gross returns per outfit ranged from $1,800 to $21,670 a year.

COMMENTS ON BUSH CLEARING BY CUSTOM OPERATORS

Various phases of custom land improvement received comment in a general way during the course of the interviews. While divergent views were held, most points received general approval or disapproval.

Basis of Charge

The hourly basis of charge was believed more satisfactory by nearly all of the operators. The hourly basis was thought best because irregular patches of land were too difficult to measure to the satisfaction of the farmer and the operator. Also, on an hourly basis, dissatisfied farmers could stop the outfit at any time if they thought progress or quality of work was too poor. On a contract basis, the farmer is bound by contract and cannot stop operations if he is dissatisfied with the quality of the work. One experienced operator was firm in his stand that work should be done on a contract basis. The hourly basis of charge allowed a high degree of inefficiency. Time was not clocked accurately; short stops were not taken off, which resulted in a smaller amount of work being done than should have been. Further than this, the hourly basis of charge allowed old, dilapidated and slow machines to operate under the disguise of an apparently efficient outfit. He said that under a contract basis more standardized rates would be set, so that comparative costs of different outfits could be more easily analysed. Some said that the hourly basis was more satisfactory but qualified their answer by adding, "if the operator was strictly conscientious and honest."

Satisfaction and Possibilities of Custom Land Improvement

Operators were of the opinion that there were great possibilities for the development of custom land improvement in northeastern Saskatchewan. They were generally confronted with more applications for work than they could handle. Some thought that opening up of new lands would continue for just a few years, after which time there would be little work left in the area. Coupled with this idea was the statement that large clearing outfits were becoming very numerous and that all arable land would soon become cleared. Others were of the opinion that development of land improvement by power machinery was dependent on the general prosperity of agriculture. As long as prices of agricultural products remained at the present relatively high level, land improvement on a generally large scale, by means of power machinery, would continue to flourish. As soon as these prices dropped, land improvement would also decline. None mentioned the possibility of a decline in agricultural prices being accompanied by a similar decline in custom rates of clearing and the program of general land improvement still carrying on. One operator stated that most of the arable land in his district had been cleared and that the rate of land improvement was declining.

Obstacles to Development

The difficulty of obtaining repairs and good, skilled labour was a major obstacle in the development of custom land improvement. Another major hindrance was the difficulty of farmers in financing such an undertaking. Recent provincial legislation, which provides protection to the homestead quarter against foreclosure, prevents farmers from being able to supply adequate security for the extension of credit. Some operators believed that the improvement of land on a farm was valuable enough to the farmer and the province as a whole to warrant the establishment of an adequate credit policy to finance such an undertaking.

In this regard, the program of the Department of Municipal Affairs in supplying credit is worthy of note. Realizing the importance of an adequate cultivated acreage in order to guarantee the settler a reasonable return from his farm, and also the general inability of many settlers to finance a land improvement program, the Department established a credit policy designed to assist in meeting these needs. The Department makes a maximum grant of $240 available to settlers for clearing and breaking, with a maximum of $100 to be used in clearing and the remainder for breaking. This service is supplied to needy settlers who have a cultivated acreage of less than 70 acres. It is provided at the rate of $5 per acre for clearing and $7 per acre for breaking. This service can be used to bring the cultivated acreage up to 70 acres. The Department realizes, in view of present costs, that the grant allowed is not enough to cover the total costs of land improvement, but states that the policy is designed to assist the settlers. The grant is repaid by means of part crop payments. Interest is charged at the rate of 5 per cent.

Operators of land clearing outfits agreed generally in principle with this credit policy, but believed that it did not go far enough. The grant of $100 for clearing does not allow the operator to work a full day on one farm. This necessitates frequent moving, which results in too high moving expenses and too much paying time lost. As a result, some operators do not bother stopping for such small jobs. Operators believed that the credit facilities available to the settlers should be enlarged so as to allow operators at least one full day on each farm.

Some operators stated that small acreages per farm made custom clearing more costly. Others stated that they did not bother with small acreages, so

that their over-all costs would not change materially with the ability of the settler to finance greater undertakings.

The high degree of stoniness in certain areas was a definite obstacle to the use of power machinery.

Requirements of Desirable Custom Operation

This phase is closely related to the previous section. Generally, the requirements are as follows: large areas or short moves; the elimination of the necessity of having to supply credit to the settlers, and in this regard more government assistance to settlers would be advantageous; freedom from stones; and in cases of small or inflexible units, not too rough topography and light cover of bush or scrub.

Prospects for Costs and Rates

Most operators were of the opinion that custom rates would soon be reduced. Keen competition among the numerous operators would bring about this result. A frequently expressed opinion, however, was that prices could not go down a great deal or net returns would be too small to warrant the high investment and risk. It was also stated that the larger outfits operated at a lower cost per acre than smaller outfits. This is substantiated to some extent by the information obtained in the survey.

SUMMARY AND CONCLUSIONS

Power equipment has done away with the extremely laborious task of land clearing by hand methods. This equipment has provided settlers with the possibility of placing their farm unit on a paying basis within a relatively short time. Areas of low agricultural productivity can be developed into a self-sustaining area in a short period of time. The advent of such equipment has confronted the settler with the problem of obtaining adequate credit facilities to finance such undertakings. The steps taken by the Department of Municipal Affairs have been a move in this direction. The relatively high level of agricultural prices has provided the needed incentive for extending the areas of productive agriculture. The high capital requirements of settlers for this type of development might be reduced when the competition of outfits becomes felt more keenly. Operating costs would indicate that such reduction might well take place and still leave operators on a reasonably sound financial basis.

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